THE MATTABASSETT DISTRICT
NEW BRITAIN - BERLIN - CROMWELL
REGIONAL SEWER AUTHORITY

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March 23, 2015

Director, Air Compliance Program
U.S. EPA New England
1 Congress Street (SEA)
Suite 1100
Boston, MA 02114-2023
Attn: Air Compliance Clerk

Re: **The Mattabassett District Water Pollution Control Facility**
Subpart LLLL (40 CFR Part 60) – Request for EPA Approval of Alternative Monitoring for Granular Activated Carbon System and Fugitive Ash.
Additional Information

To Whom It May Concern:

The Mattabassett District (MD) owns and operates The Mattabassett District Water Pollution Control Facility (MDWPCF) located at 245 Main Street, Cromwell, CT. Mattabassett District is currently constructing a new Infilco Degremont Inc. fluidized bed sewage sludge incinerator (SSI) at the facility, pursuant to Permit to Construct and Operate No. 043-0030 issued by the CT Department of Energy & Environmental Protection (CTDEEP).

This letter provides additional information on the Carbon Bed Adsorption system proposed alternative monitoring outlined in Wright-Pierce's letter dated March 4, 2015. It is our intention that this additional information may help in your review of our request for approval of alternative monitoring for the granular activated carbon system for mercury removal.

The Carbon Bed Adsorption system at the Mattabassett District is supplied by Carbon Process & Plant Engineering S.A. (CPPE). CPPE has designed and supplied carbon adsorption systems for mercury control since at least since the 1990's and has many systems on sludge incinerator systems. Attached are the following documents and a brief summary of their contents:

1. ***A list of CPPE References***. This is a list of CPPE projects related to removal of ionic mercury, elemental mercury and dioxin from the exhaust gases from a variety of applications including sludge incineration.
2. ***CPPE Recent Projects in North America***. This list of more recent projects in the US and Canada provides with both inlet and outlet mercury levels. Three of these systems are in operation, one for over 10 years and the other two for roughly 5 years. Four of these references

are still in design/construction. The Ypsilanti, MI project shows that very low levels of outlet mercury can be attained with a design outlet of 0.0016 mg/dscm. Due to the new regulations for new fluidized bed SSIs, the design a level of 0.001 mg/dscm is needed for the Mattabassett and Green Bay systems. Based on their extensive experience, CPPE has guaranteed this emission limit for the Mattabassett District.

3. ***Process Flow Diagram.*** This process flow diagram shows the instrumentation and controls for the carbon adsorption process. Exhaust from the WESP comes into the Conditioner where it passes through a mesh pad to remove any solids which may remain after the WESP. The exhaust then passes through the shell side of the heat exchanger and hot gas plume suppression air passes through the tube side of the heat exchanger. Heat from the plume suppression air transfers to the exhaust gas increasing the temperature of the exhaust gas so that it is no longer at the saturation point for water. This prevents condensation from occurring in the carbon bed. From the conditioner the exhaust gas enters the carbon bed where it passes through the sulfur impregnated carbon which removes the mercury from the gas stream. From the mercury control system, the exhaust is directed to the stack.

   The carbon system also has a startup system consisting of an exhaust bypass line, associated valves, and a startup heater and blower. During startup of the FBI system, prior to any sludge being introduced to the FBI, the startup system heats up the carbon bed system so that when the FBI exhaust goes through the carbon bed it is already hot and no water will condense on the carbon. This is accomplished by bypassing the FBI system startup exhaust (which is saturated with water due to the wet scrubbers) around the carbon system and using the startup blower to bring in outside air, heat it with the startup heater and pass the hot air through the carbon bed. Once the carbon bed is up to the proper temperature, the startup blower is shut off and the FBI system startup exhaust is directed through the carbon system.

4. ***CPPE Kombisorbon Process – Statement on Process Monitoring for Compliance***. This document describes CPPE's recommended process monitoring. Monitoring three process variables are recommended:
   a. ***Temperature difference between scrubber outlet and adsorber inlet.*** Raising the temperature of exhaust from the scrubber lowers the humidity level of exhaust gas entering the carbon adsorber vessel. This prevents condensation from occurring in the carbon adsorber bed.
   b. ***Pressure differential across the carbon adsorber.*** The pressure drop across the carbon bed normally increases very slowly over time. A sudden increase or decrease of pressure drop across the carbon bed can indicate that either a higher gas flow rate or higher level of particulate in the gas is present or that short circuiting is taking place.
   c. ***Mercury removal capacity of the carbon(available sulfur).*** The activated carbon for the CPPE process is impregnated with sulfur which reacts with mercury to form HgS. Samples of the carbon are taken via the sampling ports shown on the P&ID. Analyzing carbon samples for the available sulfur content allows the plant to determine the mercury removal potential remaining in the carbon. This allows the operators to plan for replacement of the carbon before the mercury limit is exceeded but not so prematurely as to have significant mercury removal capacity remaining in the carbon when it is replaced.

I hope this additional information is helpful in your review of our request. Should you have any questions or need additional information, please contact Melissa Hamkins at (207) 798-3738.

Sincerely,

Brian W. Armet

Brian W. Armet, PE
Executive Director, Mattabassett District

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Senior Project Manager, Wright-Pierce
melissa.hamkins@wright-pierce.com
Telephone 207-798-3738
Preparer of letter

cc. Steve Rapp, EPA
Lakiesha Christopher, CTDEEP
Keith Hill, CTDEEP
Michelle Ryan, Mattabassett District

Attachments

1. List of CPPE References
2. List of CPPE Recent Projects in North America
3. CPPE Process Flow Diagram
4. CPPE Kombisorbon Process – Statement on Process Monitoring for Compliance

Main-References

Year	Client	Location	Gas m^3/h	Removal of …	Area of application
1991	AVA - GSB Ebenhausen	Ebenhausen	70,000	Dioxin, Hg°, Hg^{2+}, Cadmium	Hazardous Incineration
1993	DRSH Zuiveringsslib NV	Dordrecht	55,500	Hg°, Hg^{2+}, Dioxin, Cadmium	Sludge Incineration
1994	Norddeutsche Affinerie AG	Frankfurt am Main	40,000	Hg°	Roast-Gas
1996	Hüls AG	Marl	45,000	Hg°	Waste Incineration
1997	Yorkshire Water Ltd.	Leeds	32,000	Hg°	Sludge Incineration
1997	Hüls AG	Marl	40,000	Hg°	Sludge Incineration
1998	Stadt Aachen	Aachen	3,000	Dioxin	Crematorium
1998	DRSH Zuiveringsslib NV	Dordrecht	41,000	Hg°, Hg^{2+}, Dioxin, Cadmium	Sludge Incineration
1998	Water Service Development	Belfast	25,800	Hg°, Hg^{2+}	Sludge Incineration
1998	Seiler Trennschmelzanlagen GmbH	Freiberg	2,000	Dioxin, Hg°, Hg^{2+}	Metallurgy Industry
1998	DOW Deutschland Inc.	Werk Stade	50,000	Dioxin	Waste Incineration
1998	Stadt Potsdam	Potsdam	4,500	Dioxin	Crematorium
1999	Dow Buna Sow Leuna Olefinverbund	Schkopau	60,000	Dioxin, Hg°	Waste Incineration
1999	Stadt Frankfurt	Frankfurt	16,000	Dioxin	Crematorium
2000	DOW Chemical	Freeport / TX	68,000	Hg°	Chemical Industry
2000	Hydro Polymers AB	Stenungsund	17,500	Dioxin	Waste Incineration
2001	Eramet	Porsgrunn	19,500	Hg°	Metallurgy Industry
2001	Eramet	Sauda	26,000	Hg°	Metallurgy Industry
2002	BASF Schwarzheide	Schwarzheide	72,000	Hg°	Hazardous Incineration
2005	Anglo Platinum	Rustenburg	17,600	Hg°, Dioxin	Metallurgy Industry
2005	Ypsilanti Community Utilities Authority	Ypsilanti/Michigan	20,600	Hg°, Dioxin	Sludge Incineration
2006	Shell Deutschland Oil	Wesseling	64,000	Hg°	Refinery
2008	Degremont	Lakeview 4 lines	126,000	Hg°, Dioxin	Sludge Incineration
2009	Degremont	Duffin Creek 2 lines	61,600	Hg°, Dioxin	Sludge Incineration

CPPE Recent References in North America
Kombisorbon® Projects for Fluid. Bed SSI

	Ypsilanti (MI, USA)	Lakeview (Canada) 4 lines	Duffin Creek (Canada) 2 lines	Mattabassett (CT, USA)	High Point (NC, USA)	Green Bay (WI, USA)	Woonsocket (RI, USA)
Year of construction	2004	2010	2013	2015 (*)	2015 (*)	2015 / 2016 (*)	2015 (*)
Flowrate (scfm, dry)	12,100	16,500	16,500	6,200	5,000	6,500	21,000
Carbon layer (inch)	20	20	20	40+	20+	40+	(**)
Hg gas inlet (mg/dscm)	0.55	0.3	0.5	1.0	0.7	0.3	0.180
Hg gas outlet (mg/dscm)	0.0016	0.005	0.02	0.0010	0.027	0.0010	0.037
Hg removal (%)	> 99.7	> 98.3	96	99.99	96	99.7	> 70

(*) Under design / construction / commissioning.
(**) Kombisorbon® Light design.

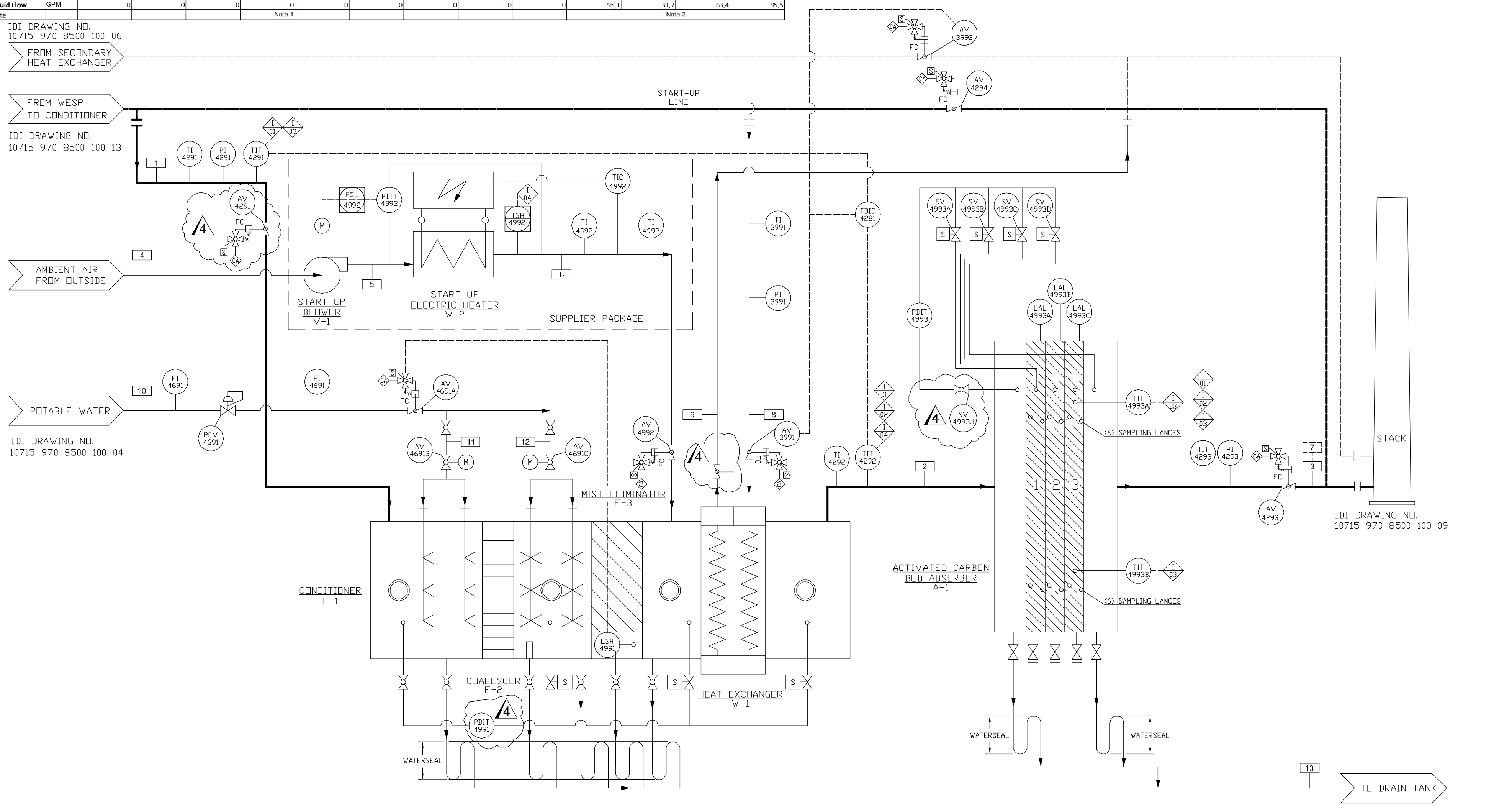
STREAM No.		1	2	3	4	5	6	7	8	9	10	11	12	13
Component		Flue Gas to Conditioner	Flue Gas to Adsorber	Flue Gas to Stack	Ambient Air for Startup	Ambient Air from Startup Blower	Ambient Air from Start-up Heater	Start-up Air from Adsorber	Plume Suppression Air to Heat Exchanger	Plume Suppression Air from Heat Exchanger	Potable Water at Battery Limit	Potable Water to Coalescer	Potable Water to Coalescer Back	Drain to Battery Limit
Dry Gas	lb/h	30772	30772	30772	18863	18863	18863	18863	9527	9527	0	0	0	0
Water Vapour	lb/h	1649	1649	1649	223	223	223	223	113	113	0	0	0	0
Dry Solids	lb/h	0,11	0	0	0	0	0	0	0	0	0	0	0	0
Water Liquid	lb/h	0,5	0	0	0	0	0	0	0	0	47577	15859	31718	47577
Total	lb/h	32421	32421	32421	19086	19086	19086	19086	9640	9640	47577	15859	31718	47577
Temperature	deg F	109	154	154	77	95	149	149	450	295	60	60	60	90
Pressure	in WG	19	15	4	0	20	20	12	5	1	2214	1190	1190	19
Pressure	PSIG	0,69	0,54	0,14	0	0,72	0,72	0,43	0,18	0,04	80	43,00	43,00	0,69
Gas Flow	ACFM	7409	8103	8287	4332	4350	4773	4900	3663	3070	0	0	0	0
Gas Flow	SCFM	7141	7141	7141	4275	4275	4275	4275	2159	2159	0	0	0	0
Liquid Flow	GPM	0	0	0	0	0	0	0	0	0	95,1	31,7	63,4	95,5
Note					Note 1						Note 2			

Note 1 : Average temperature
Note 2 : Intermittent use, 1 minute every 8 hours (to coalescer) / every 24 hours (to coalescer back)

I 01 INTERLOCKING DAMPERS
I 02 INTERLOCKING HEATING MEDIA SUPPLY
I 03 INTERLOCKING RELEASE FOR SLUDGE INCINERATION
I 04 INTERLOCKING START UP HEATER

1. ACTIVATED CARBON BED ADSORBER
LAYER 1 / LAYER 2 / LAYER 3

2. VALVES - FAIL SAFE POSITIONS
FO : FAIL OPEN
FC : FAIL CLOSED



Rev.	Prepared/Changed Name	Date	Checked Name	Approved Name	Date	Status	Kind of Revision
4	Kemenj	18.03.2014	Marchal		18.03.2014	BE	Final engineering issue
3	Vidick	12.06.2013	Marchal	Schumm	12.06.2013	BE	Second revision of BE package
2	Vidick	22.03.2013	Marchal	Schumm	22.03.2013	BE	Revision of BE package
1	Kemenj	08.03.2013	Marchal	Schumm	14.03.2013	BE	Basic Engineering issue
0	Shwe.	21.09.2012				FI	First issue

Carbon Process & Plant Engineering S.A. www.CPPE.lu

Mercury Control Activated Carbon System
KOMBISORBON® PROCESS
Process flow diagram

Scale : %
Original Size : A1
Client project No. : 1110715
Client item component : 0901
Job No. 10045-01
Document No. CP 1001
Rev. 4
Job name: Mattabassett

CPPE Kombisorbon® Process

Statement on Process Monitoring for Compliance – Mercury Removal from SSI Off-Gas
Establishment of Operating Limits for Emission Control Equipment – SSI MACT Rule 60.5175

CPPE's Kombisorbon® process has been developed and applied for mercury removal from sewage sludge incineration installations since the 1990's. It is a fixed bed process, using sulphur-impregnated carbon to chemisorb both ionic and elemental forms of mercury from the gas stream before release to the environment via the stack. The technology has been recognised as a Best Available Technology in both Europe and the USA for mercury removal from SSI plants. During this time, the development of appropriate and meaningful monitoring programs has been ongoing, to provide our clients with assurance of the process performance for mercury removal. There has been increasing recognition of the importance of upstream process performance on the stability and reliability of the mercury removal system, resulting in ongoing improvements to overall system integration.

Currently we recommend to our clients to perform continuous monitoring both through online measurements using process instrumentation (temperature and pressure) and through periodic sampling and analysis of the carbon (from several key locations in the fixed bed) to estimate the remaining mercury capacity of the carbon. This provides important information for developing a profile of carbon exhaustion (mercury breakthrough) and predicting the requirement for replacement of the carbon.

Subpart 60.5175 of the USEPA's new sewage sludge incineration emission regulations outlines the requirement for owners to monitor parameters that will verify compliance of pollutants for periods between scheduled stack testing.

The Kombisorbon® process is normally the final step in the SSI gas treatment flow sheet; reliable long-term performance relies upon proper design and operation of upstream processes. It is important that the flowrate and quality of the influent gas to the Kombisorbon® process respect the design conditions. This should be part of the overall system compliance monitoring program.

Based on the monitoring programs already in place at a number of SSI's using our Kombisorbon® system for mercury control, we are confident that the developed programs will support the USEPA regulations for compliance monitoring. We will continue to support our clients to integrate this procedure as a regulated component of their overall emissions compliance program. This will form part of the training program, both classroom and in-plant/laboratory, to ensure that both monitoring monitoring and testing requirements can be managed by client. Note that depending on the laboratory facilities, some analyses may need to be carried out in an external certified laboratory.

It is recommended to monitor three key process variables for the Kombisorbon® mercury removal system:

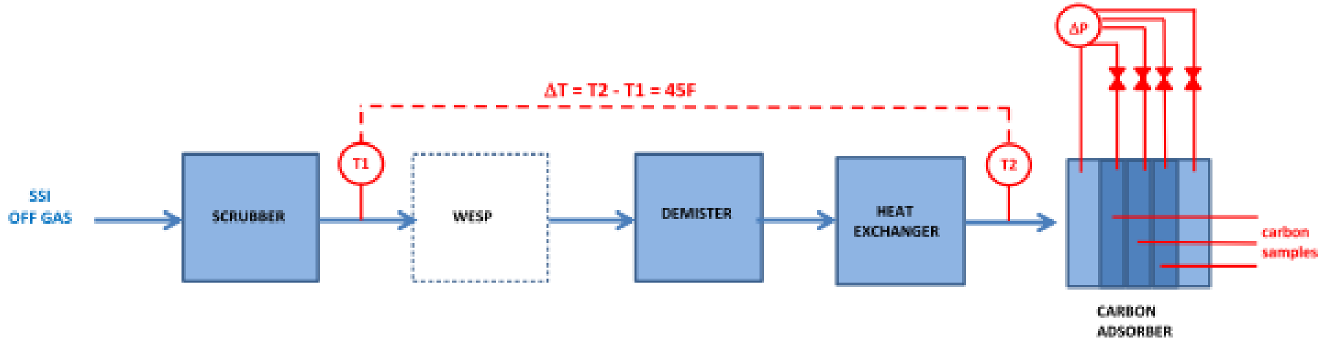
1. Temperature difference (ΔT) between scrubber outlet and adsorber inlet

2. Pressure difference (ΔP) across the adsorber

3. Mercury removal capacity of the carbon (available sulphur) – analysis of Carbon samples

CPPE Carbon Process & Plant Engineering S.A.
Address: Industrial Complex ArcelorMittal, rue de la Cimenterie, L-1337 Luxembourg-Dommeldange, Grand Duchy of Luxembourg
Commercial Register: Luxembourg B 137066 - VAT-Reg.-No.: LU 22396036 - Tax ID No.: 2008 2205 501
Board of Directors: Dr. Ing. Alain Strickroth (CEO), Egbert Montag, Stefan Schöppel, Bruno Schumm, Peter Wanken

Below is a simplified sketch showing the location of these monitoring points in the Kombisorbon process.



Details of the five listed requirements of the petition are given below for each of the recommended compliance monitoring parameters.

1. (i) **Temperature difference between the scrubber outlet and adsorber inlet (ΔT)**

(ii) It has been established that the relative humidity of the feed gas to the adsorber is important to mercury removal efficiency, and that condensation of moisture into the carbon should be avoided.

(iii) The lower limit for ΔT is set at 45^{o}F (25^{o}C); this ensures protection against condensation and provides a conservative margin against dewpoint of the gas feed to the adsorber. The upper limit for gas temperature, based on materials of construction (Fiber Reinforced Plastic - FRP) is set at 176^{o}F (75^{o}C).

(iv) Measurement of gas temperature at scrubber outlet, and adsorber inlet, should be via continuous online measurement with temperature sensors (thermocouple with thermowell) properly installed in the gas ducts. These are connected to transmitters to send signals to the plant PLC for alarming, switching and trending purposes. Relative accuracy of 0.5^{O}F and precision of >99% for the thermocouple/transmitter system should be specified for instrument selection.

(v) Frequency of recalibration of temperature sensor/transmitter is recommended every 12 months. The procedure for recalibration is provided by the instrument manufacturer. We recommend the provision of a transmitter system which provides detection of sensor drift, and degradation of the thermocouple.

2. (i) **Pressure differential across the carbon adsorber (ΔP)**

(ii) The pressure drop across the carbon is an indication of the buildup of dust, moisture or precipitates, and is normally a very slow and gradual increase over time. An acceleration of the rate of increase in ΔP across the adsorber is an indication that the process has been operating outside the recommended (design) envelope (e.g. high gas flow rate, presence of contaminants in the gas). In addition, a sudden decrease in pressure drop across the system will indicate that the gas flow is short-circuiting the carbon layer(s). Operation outside the design envelope will compromise the reliability of the mercury removal performance of the system. The pressure drop across each of the carbon layers in the adsorber is continuously measured and recorded. During normal operation the pressure drop across the complete bed is recorded and trended on the plant computer – this provides long term monitoring.

(iii) Upper values will be in accordance with design maximum pressure drop, estimated for maximum gas flowrate at end of life. This maximum limit is in line with high pressure differential alarm setpoint. Averaging periods are taken over intervals of twenty minutes.

(iv) Differential pressure measurement is arranged with one pipe on the upstream leg and four pipes on the downstream leg of the sensor, in order to measure the pressure drop at several depths of the carbon bed. The differential pressure sensor is connected to a transmitter which sends the signal to the plant's programmable logic controller (PLC). Relative accuracy of the differential pressure monitoring system should be within ±0.25"WC, with a precision of >95%.

(v) Frequency of recalibration of differential pressure sensor/transmitter is recommended every 12 months. The procedure for recalibration is provided by the instrument manufacturer.

3. (i) **Mercury removal capacity of the carbon (available sulphur) – analysis of Carbon samples**

(ii) The activated carbon used in the Kombisorbon® process is impregnated with sulphur to 10-13wt% - this sulphur reacts with mercury to form HgS. There is a direct relationship, between the measurement of mercury removal capacity (available sulphur) of the carbon at various depths of the carbon bed, and the emission of mercury from the process. As the available sulphur content of the carbon decreases, the lifetime of the activated carbon bed for mercury removal reduces. The lifetime of the carbon is estimated based on the design concentration of mercury, dioxins and furan and gas flow rates. In practice, the concentrations may vary. The mercury removal capacity of the carbon may be influenced by: the actual Hg concentration of the gas to the Kombisorbon® process – this depends upon the sludge composition and combustion; upstream treatment and Hg removal efficiency – e.g. wet scrubber operation; other pollutants in the gas – heavy metals, acids, dioxins; moisture content and temperature of the gas feed. Basically, the available sulphur content of the carbon will determine the mercury removal potential remaining for the process.

(iii) Of importance are the lower values for mercury removal capacity (available sulphur) of the carbon. Under normal operation, the available sulphur sites on the activated carbon are exhausted by chemisorption with the mercury to form a tightly held HgS activated compound in the carbon. We would recommend initially monthly samples to establish the saturation behaviour of the carbon bed, then a minimum of once every six months. Sampling of the carbon is from each of the layers in the adsorber, from the four sampling points each carbon layer. A predictive curve should be established and verified to forecast the replacement and program maintenance activities for this. This enables the carbon replacement program to occur well before the Hg limits are exceeded, but not prematurely so that close to the full value of the carbon can be used. When the available sulphur content of the carbon in a particular layer reaches ≤ 20% then proceed with planning for replacement of the carbon for that layer.

(iv) The available sulphur content of the carbon is calculated from measurements of (A) total sulphur (B) sulphate and (C) mercury content of the carbon. The available sulphur content is estimated in accordance with the following:

Available Sulphur content (wt%) = A – B - (C*32.07/200.59)

Where A = total sulphur content (wt% as S)
B = sulphate-sulphur content (wt% as S)
C = mercury content (wt% as Hg)

Molar weights:
Hg = 200.59 g/mol
S = 32.07 g/mol

Chemisorption: $Hg + S \rightarrow HgS$
1 mol Hg bonds with 1 mol S

(A) **Determination of the total sulphur content** of the activated carbon uses a LECO-analyser. The instrument (LECO SC-144 DR) burns a portion of the ground carbon sample in an oxygen atmosphere. The oxygen passes an infrared detection system where the total amount of formed SO_2 is detected. A computer calculates the total sulphur content of the carbon sample from the total amount of the sample mass used for the determination.

(B) **Determination of the sulphate content** of the activated carbon is performed firstly by applying the quantitative extraction of water soluble substances. Then after acidifying and boiling the extracted solution, and forming a precipitate by addition of $BaCl_2$, gravimetric and titrimetric determinations are performed to estimate the sulphate concentration of the sample of known mass (US EPA Method 375.3 – Sulphate (Gravimetric).

(C) **Determination of the mercury content of the carbon** is performed using an approved method (e.g. US EPA Method 7471B) whereby the solids sample is digested followed by application of atomic absorption spectrophotometry.

(v) These analyses should be performed by a certified laboratory to ensure compliance with USEPA requirements. The frequency and methods for recalibration of instrumentation shall therefore correspond to the certification obligations of the testing laboratory.

We recommend the summarised schedule of monitoring described in Table 1 below.

Table 1. Recommend schedule of compliance monitoring for Kombisorbon process for mercury removal for SSI plants

Item	Parameter	Frequency of Monitoring	Method of Monitoring
1a.	**Temperature** Exit of Scrubber	Continuous online	In-duct thermocouple / transmitter to PLC
1b.	**Temperature** Inlet to Adsorber	Continuous online	In-duct thermocouple / transmitter to PLC
1c.	**Differential Temperature** Between scrubber exit and feed gas to adsorber	Continuous (calculation)	Calculation of Item 1c = 1b - 1a made in the PLC
2.	**Differential Pressure** Total across adsorber	Continuous	Discharge plenum pressure referenced to inlet plenum pressure
3.	**Mercury Capacity of Carbon** / Remaining Available Sulphur	Monthly initially for the first three months to establish saturation behaviour of the carbon bed. Then every six months.	Sampling lances provided in each layer of carbon; analysis per recommendation for S, Hg and SO_4, calculation of available sulphur.